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AN ATTEMPT

TO ESTABLISH

THROUGHOUT HIS MAJESTY'S DOMINIONS

AN UNIVERSAL WEIGHT AND MEASURE,

DEPENDANT ON EACH OTHER,

AND CAPABLE OF BEING APPLIED TO EVERY NECESSARY PURPOSE WHATEVER.

BY WILLIAM MARTIN,
TREASURER TO THE AIRE AND CALDER NAVIGATION, WAKEFIELD.

THOU SHALT HAVE A PERFECT AND JUST WEIGHT,
A PERFECT AND JUST MEASURE SHALT THOU HAVE.
DEUT. XXV. 15.

LONDON:
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1794.

TO

THE RIGHT HON. WILLIAM PITT,

FIRST LORD OF THE TREASURY,

AND CHANCELLOR OF HIS MAJESTY'S EXCHEQUER.

SIR,

As a loyal and dutiful ſubject, and a well-wiſher to our preſent happy conſtitution, the permiſſion of addreſſing this ſmall Tract to you affords me a peculiar pleaſure. It is ſent into the world without any other view than that of laying a foundation for a plan to reſcue the public from an inconveniency, under which they have long laboured. Should it be favoured with your patronage, and anſwer the intended purpoſe, the idea of having been uſeful will be an ample gratification to,

SIR,

Your moſt obedient,

And faithful humble Servant,

WILLIAM MARTIN.

PREFACE.

The difficulties and perplexities which continually ariſe to men of Trade and Commerce, from the variety of Weights and Meaſures uſed in different parts of England, are ſo well known from experience, that little apology is required for attempting to remove them. Many ingenious gentlemen, mathematicians and philoſophical mechanics, have attempted to find out ſome method of fixing one invariable Standard for forming a General or Univerſal Syſtem of Weights and Meaſures throughout the whole world. Their endeavours have entitled them to much commendation, although the public have not yet received any benefit from their labours; owing, in my opinion, to an over and above delicacy about mathematical exactneſs, and which is not eſſentially neceſſary in trade. In this ſmall Tract I have endeavoured to keep as cloſe to truth and exactneſs as the ſubject would admit of; though it is not offered as perfect, and without error; yet I think I may venture to ſay, that there is not any thing of that conſequence, but that it may be adopted as the foundation of a Syſtem for reducing the Engliſh Weights and Meaſures to certain Standards, dependant upon each other, ſufficiently exact to anſwer all the purpoſes of Trade and Commerce, which is the principal object I have aimed at.

I am certain that Standard Weights, adjuſted to the ſuppoſition of one cubic foot of water (according to the length of a ſecond pendulum, being 39.2 inches, or even to Mr. Troughton's ſcale) weighing 1000 ounces Avoirdupoiſe, would come ſo near the preſent Avoirdupoiſe weight, as not to make any material difference in the reductions made uſe of in this book. However, if upon experiment it ſhould not be deemed near enough to the truth, a method is ſhewn, upon the ſame principle, that will perfectly coincide with the reſult of experiment.

The method of reduction is fully explained, ſo as not to leave room for any objection being made reſpecting the public revenues; and I am inclined to think that the diviſions into different denominations of the new propoſed Weights and Meaſures, according to the tables, are as well formed for the uſe of Merchants and Tradeſmen as any other whatever.

There, doubtleſs, are perſons who will find fault with this performance. To theſe I anſwer, that I do not ſend it out under the notion of its being a work perfect in itſelf; but rather to incite others, better qualified than myſelf, to engage their thoughts upon the ſame ſubject. I do not publiſh for the ſake of pecuniary advantage, or the ambition of being an author, but merely for the benefit of mankind; and therefore, if what I have done turn out to be any ways uſeful, I ſhall thereby conſider myſelf amply rewarded. My principal wiſh is, that the public may receive it under the ſame idea that induces me to ſend it forth, a deſire of being beneficial to them; that they will treat any imperfections or miſtakes they may meet with in a candid manner; and that thoſe, who are diſſatisfied with it, will produce ſomething of their own, better adapted to the purpoſe, rather than be cenſorious upon what does not perfectly coincide with their own ideas.

If a decimal coinage could be obtained, the diviſions into the different denominations might be adapted thereto, ſo as to ſimplify calculations and the method of keeping accounts; but that, it is feared, is a work of too much conſequence to be expected at preſent.

W. M.

THE meaning of the characters made uſe of in this book is well known to the generality of Arithmeticians; however, obſerve

That × is the ſign of multiplication, and ſhews that whatever numbers it is placed between are multiplied together; as, page 17, 16×1.25 means that 16 is multiplied by or with 1.25.

= Equal, ſhews that whatever numbers, or the reſult of numbers, it is placed between, are equal; as, 16×1.25=20 means that the product of 16 multiplied with 1.25 is equal to 20.

: :: : Proportion, which ſhews that the numbers are in proportion; as, page 19, 16:19.9::1:1.24375, and are read thus; as 16 is to 19.9, ſo is 1 to 1.24375.

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Such great inconveniencies attend the variety of Weights and Meaſures uſed in England, that it has long attracted the attention of many ingenious perſons, to have one general Weight and Meaſure for all kinds of commodities eſtabliſhed throughout his Majeſty's dominions.

The learned Mr. John Greaves, ſome time Profeſſor of Aſtronomy in the Univerſity of Oxford, in a treatiſe, entitled, 'The Origin and Antiquity of our Engliſh Weights and Meaſures diſcovered,' the ſecond edition, printed in the year 1745, has with great ingenuity ſhewn that they were taken from certain ſtandards found in one of the Egyptian pyramids, and therefore are of very great antiquity indeed. In the proſecution of this work he has pointed out the analogy there is between the Scripture Weights and Meaſures, and thoſe of England and other parts of the world. Theſe ſpeculations, though pleaſing and intereſting to antiquarians, are not a ſufficient reaſon why the preſent Weights and Meaſures ſhould be continued in uſe, provided others, better adapted to the purpoſes of trade and commerce, can be ſubſtituted in their place. The intent of this ſmall tract is to endeavour to obtain that end.

The firſt thing, and what is moſt eſſentially neceſſary, is to find out ſome invariable method for adjuſting the ſtandard integers of Weights and Meaſures, that they may continue the ſame through all ſucceeding ages of the world. We now ſay that one ounce is the ſixteenth part of one pound Avoirdupoiſe, as an integer; and alſo that one inch is the twelfth part of a foot, as an integer: but then we are not certain that the pound Avoirdupoiſe, nor that the Engliſh foot, are the ſame now as they were a thouſand years ago; becauſe there has not been any invariable method uſed for adjuſting them from time to time. Mr. Greaves, p. 34, ſuppoſes that the ancients took their ſtandard for Weights from the weight of water. At p. 37 and 38 he ſays, that in the year 1696, Thomas Everard, Eſq. and others, in the preſence of ſeveral Members of the Houſe of Commons, weighed very exactly 2145.6 cubic inches of common ſpring water; which they found to be 1131 ounces and 14 penny weights Troy, equal to 94lb. 3oz. 14dwts. or in decimals 94.308333 pounds Troy. Then, as 2145.6 cubic inches, is to 94.308333 pounds, ſo is 1728 cubic inches (or one cubic foot) to 75.953019 pounds Troy. That is, one cubic foot of this water will in that proportion weigh 75.953019 pounds Troy. If any number of pounds Troy be multiplied by the common factor, .822857, the product will be the pounds Avoirdupoiſe contained therein, as will be hereafter ſhewn. Hence 75.953019 multiplied by .822857 is equal to 62.498473355283 pounds Avoirdupoiſe, which, reduced into ounces, is 999.975573684528. This wants only .024426315472 decimal parts of one ounce to make it 1000 ounces.

Mr. John Ward, in his Young Mathematician's Guide, p. 121, fifth edition, obſerves that, notwithſtanding the account given in the Philoſophical Tranſactions of many experiments made about the weight of different bodies, he had for his own ſatisfaction made ſeveral experiments of that kind, and preſumes that he had obtained the proportions of weight that one bears to another of the ſame bulk or magnitude. In a table which he has introduced he makes the weight of a cubic inch of common clear water .578697 ounces Avoirdupoiſe. This multiplied by 1728, the cubic inches contained in one ſolid foot, produces 999.988416, which wants only .011584 decimal parts of being 1000 ounces.

That learned and ingenious mathematician and philoſopher, Mr. Emerſon, in his Treatiſe on Mechanics, p. 130, third edition, ſays, that a cubic inch of water weighs .5787 ounces Avoirdupoiſe; and conſequently a cubic foot weighs $\overset{\text{oz.}}{999.9936}$. As he does not ſay that it is the reſult of experiments, it may be preſumed that he has taken it from Mr. Ward's book, calling .578697 .5787, which is very near.

Mr. Benjamin Martin, in his Philoſophia Britannica, Vol. I. p. 286, ſecond edition, ſays, that a cubic foot of water weighs very nicely 1000 ounces Avoirdupoiſe; from which he formed his tables of ſpecific gravities.

It does not appear from what kind of experiments the weight of water was obtained. Mr. Everard is ſaid to have weighed very exactly 2145.6 cubic inches; but no mention is made how that quantity was meaſured. In the Philoſophical Tranſactions, No. 169, a veſſel made of well-ſeaſoned oak, containing exactly one cubic foot, is ſaid to have been filled with pump water, and weighed 1000 ounces. I preſume an experiment made in that manner could not be very accurate, particularly if the veſſel was an open one. In making experiments about the weight of water, the greateſt nicety is abſolutely neceſſary to be obſerved. To aſcertain the weight of a cubic foot of water to a few grains is attended with very great difficulty; and yet in this caſe it is neceſſary to be done. The authorities already quoted have great weight, and I doubt not but are near the truth, viz. that a cubic foot of pure water weighs 1000 ounces Avoirdupoiſe. But more of this hereafter.

Water ſeems the beſt adapted of any thing for adjuſting Weights and Meaſures of capacity by, as it is always to be had near at hand; but then it is to be obſerved, that all kinds of water will not anſwer the purpoſe; for if it be impregnated with ſalts, or other mineral ſubſtances, its gravity is thereby altered. It appears that Mr. Everard made his experiment with common ſpring water; I preſume ſuch as was pure from all kind of ſalts and mineral ſubſtances. The gravity of rain water, as it falls pure from the clouds into a clean veſſel, is always nearly the ſame, and moſt to be depended upon; and conſequently ought always to be uſed in theſe kind of experiments.

Writers upon mechanics, and the mathematical principles of philoſophy, demonſtrate that a pendulum vibrating ſeconds in our latitude muſt be 39.2 inches long from the point of ſuſpenſion to the center of oſcillation within the ball; and the center of oſcillation moving in the curve of a cycloid. The ſame writers ſhew by what means a pendulum may be made to vibrate in that curve, but allow at the ſame time, that if the vibrations are made very ſmall in the arch of a circle, the difference will be leſs than materially diſtinguiſhable by our ſenſes. The re-

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The late Mr. Whitehurſt, as a mechanic, has with great ingenuity deſcribed a method which he purſued, upon a plan firſt laid before the Society for the Encouragement of Arts, Manufactures, and Commerce, by Mr. John Hatton, watchmaker, in London, for finding the exact length of a pendulum vibrating ſeconds in the latitude of that place. This Mr. Whitehurſt publiſhed in the year 1787. There is a variety of obſtacles in the way which are to be counteracted in making theſe kind of experiments; as the different degrees of heat and cold, variety of ſituations, and other cauſes, occaſioning a difference in the reſiſtance of the medium of air, and above all, the general imperfection of human nature, that mankind cannot work to mathematical exactneſs. Theſe and other interfering circumſtances prevented that ſatisfactory reſult, which, it may be preſumed, he expected to have found. At p. 17 he ſays, that a pendulum vibrating ſeconds in the latitude of London is 39.1196, and not 39.2 inches, as commonly ſuppoſed. If he has drawn this concluſion from his own experiments, I think he has made a ſmall error, for he ſhould have ſaid 39.12944[*].

For the conveniency of mankind in general, and particularly thoſe concerned in trade and commerce, there is undoubtedly ſomething wanting to be done, to eſtabliſh one certain and general Weight and Meaſure; and if theſe can be made to depend upon, and to correſpond with each other, ſo much the better. Could it be extended to all parts of the world, and that from invariable ſtandards, mathematically exact, it would be a very pleaſing circumſtance; but that I will venture to pronounce impoſſible, for the reaſons before given. Indeed mechanical experiments are imperfect in general; for notwithſtanding they are the baſis and foundation of philoſophy, yet they are only approximations, by which the truth of theory is in a great degree confirmed.

It is the inconveniency we daily labour under from the variety of Weights and Meaſures of capacity now uſed in England, that induced me to turn my thoughts to this ſubject. If that mathematical exactneſs, ſo much deſired by gentlemen of ſcience, cannot be obtained, that can be no reaſon why theſe ſhould continue as they are. The length of a pendulum vibrating ſeconds in our latitude may certainly be come at near enough to eſtabliſh a ſtandard to anſwer the purpoſes of trade. It is not of very material conſequence whether it be 39.2 or 39.12944 inches, the difference being ſo ſmall. I do not think that what Mr. Whitehurſt has done is ſufficient authority to ſay that 39.2 inches is not the length of a ſecond pendulum, without any material ſenſible difference, particularly from a remark made by the late Mr. Michel in Mr. Whitehurſt's book, which he lent to me, about the ſtretching of the wire made uſe of in his experiment; therefore we will for the preſent admit it to be ſo.

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[*] Mr. Bradley ſuppoſes 39.126. Phil. Tranſ. No. 432.

It is not here preſumed to direct what method is beſt to be taken, to transfer the length of a pendulum vibrating ſeconds in our latitude, to a ſcale made of an even poliſhed bar of iron, or other ſubſtance, the leaſt liable to expand and contract by heat and cold, provided for that purpoſe; that being left to the ſkill of an able artiſt, it only being ſuppoſed that it is capable of being done. Let this length ſo laid down be divided into ſeven equal parts, and each of thoſe again divided into ſeven other equal parts, and laſtly each of thoſe parts ſubdivided into eight other equal parts, then the whole length will be divided into 392 equal parts, becauſe $7 \times 7 = 49$ and $49 \times 8 = 392$, and conſequently (admitting that a pendulum 39.2 inches long vibrates exact ſeconds of time) each of theſe ſmall diviſions will be one tenth part of one inch, and therefore 120 will be 1 foot, 240 2 feet, and 360 3 feet or 1 yard.

This ſcale or ſtandard ſhould correſpond with the weight of water, ſo that one cubic foot, or 1728 cubic inches, according to this meaſure, ſhould weigh 1000 ounces Avoirdupoiſe. To prove this, let a veſſel be provided in ſhape of Fig. 1, made of braſs plates, perfectly even, and ſmooth on the inſide, with grooves for letting one into another, cut exactly to the given dimenſions, and ſo fixed together by ſcrews, or in ſuch other manner as an able artiſt ſhall find beſt, that all may remain firm and immoveable.

A B, the greater ſide of the baſe . . . . . = 6
B C, the leſſer . . . . = 4 } Inches.
D C, the depth . . . . = 9

Then A B×B C×C D=216 cubic inches, the content of the veſſel, which is the eighth part of one cubic foot.

As it is a very difficult matter to fill an open veſſel of any conſiderable dimenſions with water, ſo as exactly to be full and no more, let the top be covered with a ſtrong even braſs plate E F G D, with a ſmall orifice in the middle, to put the water in at by a funnel. To this orifice let there be fixed a braſs ſlide as S, that when the veſſel is filled with water, the orifice may be exactly fitted by the ſlide even with the underſide of the plate, ſo that the veſſel may retain juſt as much water ſhut up within it, as will exactly fill it, and no more. Let the veſſel thus filled with pure rain water be exactly weighed in a fine balance, and from that weight deduct the weight of the veſſel when empty, perfectly dry, and clean, the difference will of courſe be the exact weight of the water. Now if a pendulum vibrating ſeconds be exactly 39.2 inches long, and that length be accurately transferred to the ſcale from which the dimenſions of this veſſel is ſuppoſed to be correctly taken, and alſo if a cubic foot of rain water weigh juſt 1000 ounces Avoirdupoiſe, the weight of this water will be exactly 125 ounces Avoirdupoiſe. The nicety required in the workmanſhip, and other obſtacles in the way of theſe experiments, as before taken notice of, will moſt probably ſo far prevent minute accuracy, as not to anſwer perfectly exact: however, if the work be performed, and the experiment made with the utmoſt care, it is preſumed the reſult will be ſatisfactorily exact. By this means the weight of a cubic foot of water, according to the meaſurement of this ſcale, is obtained; which may be a ſtandard dependent upon the meaſure of length, and from which all other weights may be derived.

Let this weight of the water contained in the braſs veſſel be exactly divided into 125 equal parts, or eight times that weight divided into 1000 equal parts, which call ounces; each of theſe ounces may be divided into 20 equal parts called pennyweights, and each pennyweight into 20 equal parts called grains; and for nice experiments thoſe grains may be divided decimally into any required degree of exactneſs.

It is probable that a greater degree of nicety may be obtained by uſing a cylindrical veſſel, than one made as now deſcribed; as it is poſſible to bore one very near true. The diameter of a circle whoſe area is four inches, is 2.2567 inches. Suppoſe a cylindrical veſſel, Fig. 2, ſome little more than 13.5 inches long, be bored to this diameter, according to the meaſure taken from a ſecond pendulum, laid down upon a ſcale, and divided in the manner as mentioned, p. 8, which ſuppoſes its length to be 39.2 inches as a ſtandard meaſure. To this cylinder (C) let there be a piſton (P) made perfectly even on the under ſide, exactly of the ſame diameter with it, to which fix an iron ſtem (S) upon its center, ſtanding perpendicular thereto, with a fine ſcrew cut upon it, containing juſt 20 threads in one inch, paſſing through an horizontal braſs plate (nn) of ſufficient thickneſs, with a female ſcrew adapted to that on the ſtem. To the ſcrew if an index (I) be fixed, to move round in a circle or dial plate divided into 50 equal parts or degrees, then it is evident, that for every diviſion this index be moved, the piſton will be raiſed or lowered one thouſandth part of one inch. Let an index (i) be applied to the ſtem, ſhewing when the under ſide of the piſton is exactly 13.5 inches from the bottom of the cylinder. Even with the under ſide it may be proper to fix a ſmall valve (v) in the piſton, to let out the overplus water. Let the cylinder be filled to 13.5 inches, or ſome little more, with pure fine rain water. Into the top of the cylinder fix the piſton, and lower it while it appears to be juſt 13.5 inches from the bottom. Then fix down the valve, and with a ſpunge or cotton wool take off all the water which may be found upon the piſton, wiping all perfectly dry. Weigh the whole very exactly in a fine balance, and if it be found that the neat weight of the water be exactly 31$\frac{1}{4}$ ounces Avoirdupoiſe, it evidently ſhews that this meaſure and weight correſpond with each other; and if the weights made uſe of be exact with the Avoirdupoiſe ſtandard, it proves the whole theory to be right, that a pendulum vibrating ſeconds is 39.2 inches, and that one cubic foot of pure, fine rain water weighs juſt 1000 ounces Avoirdupoiſe. If this ſhould not be the caſe, divide the weight which the water contained in the cylinder actually weighs into 125 equal parts, as in the firſt experiment, four of which will be a ſtandard ounce correſponding with this meaſure. If the experiment be repeated a number of times, it is moſt probable that the reſult will not always be exactly the ſame, though if made with care it muſt be very near; therefore it will be the beſt to take the average of theſe reſults. It is neceſſary to take care that the temperature of the air be always the ſame in laying down the length of the pendulum, adjuſting the dimenſions of the veſſels, and making theſe experiments; ſuppoſe 55, according to Fahrenheit's ſcale.

If it ſhould be thought more eligible to make the weight the ſtandard, and adjuſt the meaſure to it, proceed thus: If the weight of the water in the cylinder, when filled to 13.5 inches, be greater than 31$\frac{1}{4}$

ounces, fix the index upon the dial plate to 50 (the water being then ſuppoſed to ſtand to juſt 13.5 inches), and lower the piſton until as much water be diſcharged through the valve, as will reduce that remaining to 31¼ ounces, the weight required. The index will point out how much the piſton has been lowered, and conſequently the length of the cylinder holding that weight of water. If this length be divided into 27 equal parts, 24 of them will be the ſtandard foot, adjuſted to Avoirdupoiſe weight. If the weight of the water filled to 13.5 inches be leſs than 31¼ ounces, then as much muſt be added as will make it exactly that weight, by which the piſton will be raiſed, and conſequently the diſtance from the under ſide of it to the bottom of the cylinder increaſed. This length divided as before, the ſtandard foot will be obtained, adjuſted to Avoirdupoiſe weight. Though this method of adjuſting meaſure to weight be not perfectly true, yet it comes nearer than to produce any material error; but as it is preſumed to be much better to adjuſt the weights to meaſure, it is of no conſequence.

Let 20 of theſe ounces be ſubſtituted as a new and univerſal pound weight, from which all ſuperior denominations ſhall be derived, according to the following table.

20 Grains	MAKE	1 Pennyweight.
20 Pennyweights		1 Ounce.
20 Ounces		1 Pound.
100 Pounds		1 Hundred.
20 Hundreds, or 2000 Pounds		1 Ton.

By this means the columns uſed for hundreds and quarters in account books would be laid aſide, all groſs articles would be weighed and expreſſed by hundreds, pounds, ounces, and pennyweights, and would ſtand thus, $\overset{\text{lb.}}{15,65}\ \overset{\text{oz.}}{6}\ \overset{\text{dwts.}}{14}$, where all the figures in the column of pounds ſtanding to the left of the two firſt, expreſs hundred weights. By theſe weights all wares, merchandiſe, commodities, and things whatever, ſhould be bought, ſold, rated, and valued, throughout his Majeſty's dominions in all parts of the world.

I am aware of two very material, and weighty objections, which may be brought againſt this propoſed alteration in the Engliſh Weights and Meaſures.

Firſt, by Merchants and Tradeſmen, who have all their lives been accuſtomed to the Weights and Meaſures now in uſe; and therefore they will be at a loſs, how to fix the value of their goods and merchandiſe by thoſe now propoſed.

Second, by his Majeſty's Officers for charging and collecting the duties of Cuſtoms and Exciſe laid upon different kind of goods, wares, and merchandiſe, by various acts of Parliament, to anſwer different purpoſes of ſtate.

Though theſe objections appear very formidable, yet upon inveſtigation they will not be found of ſuch Herculean conſequence, but that they may be eaſily obviated, which I will now endeavour to ſhew.

REDUCTION OF AVOIRDUPOISE,

WITH THE RATES THEREOF TO THOSE OF NEW WEIGHT.

It is preſumed, as is before obſerved, that the new ounce is equal, or without any material ſenſible difference, to the old Avoirdupoiſe ounce.

The new propoſed pound is equal to 20 ounces Avoirdupoiſe.

The common Avoirdupoiſe pound contains 16 ditto.

Then conſequently the Avoirdupoiſe pound, is to the new pound, as 16 to 20, or as 4 to 5. Therefore 4:5::1:1.25, that is, 1 pound new weight is =1.25, or $1\frac{1}{4}$lb. Avoirdupoiſe. From hence it follows, that if any number of pounds new weight, be multiplied by the common factor or multiplier 1.25, the product will be the number of pounds Avoirdupoiſe equal thereto. As for inſtance, if it were required to know how many pounds Avoirdupoiſe are contained in 248 pounds new weight, it will be 248×1.25=310, the pounds required, the ſame holds univerſally true in all others.

In 100lb. (the propoſed new hundred weight) are 2000 ounces.

In 112lb. (the hundred weight Avoirdupoiſe) are 1792 ditto.

Therefore the Avoirdupoiſe hundred is to the new hundred weight as 1792 is to 2000, or as 112 is to 125∵112:125::1:1.1160714; that is, one hundred new weight is equal to 1.1160714 hundreds Avoirdupoiſe weight; and conſequently, if any number of hundreds new weight be multiplied by it, the product will be the number of hundreds Avoirdupoiſe equivalent thereto; as if it were required to know how many hundreds Avoirdupoiſe are equal to 560 hundreds new weight: 560×1.1160714=624.999984=625 nearly.

As 20 hundreds conſtitute the ton both in the new and Avoirdupoiſe weight, the ſame factor (1.1160714) will reduce any number of tons new to Avoirdupoiſe weight; as, 22.4 tons new weight ×1.1160714=24.99999936=25 tons nearly.

The rate per pound, hundred, or ton, Avoirdupoiſe weight, is to the rate per pound, hundred, or ton, new weight, as the Avoirdupoiſe pound, hundred, or ton, is to the pound, hundred, or ton, new weight; therefore the ſame factors which reduce new to Avoirdupoiſe weight, will reduce the rates of Avoirdupoiſe to the rates new weight. Hence the following

GENERAL RULE.

If the rate be by the pound Avoirdupoiſe, multiply it by 1.25, and if by the hundred or ton by 1.1160714, and the product in each caſe will be the rate required for new weight.

EXAMPLE I.

What rate per pound new weight, muſt be charged to be equal to 1s. 4d. per pound Avoirdupoiſe?

$\overset{s.}{1}\ \overset{d.}{4}=\overset{d.}{16}.\qquad 16\times 1.25=\overset{d.}{20}=\overset{s.}{1}\ \overset{d.}{8}$ the rate required.

EXAMPLE II.

At what rate per pound, new weight, muſt tea be ſold, to be equal 6s. 4d. per pound Avoirdupoiſe?

$\overset{s.}{6}\ \overset{d.}{4}=\overset{d.}{76}\qquad 76\times 1.25=95$ pence $=\overset{s.}{7}\ \overset{d.}{11}$

EXAMPLE III.

The cuſtom duty upon cloves imported is 2s. 8d. per pound Avoirdupoiſe, what is that per pound new weight?

$\overset{s.}{2}\ \ \overset{d.}{8}=\overset{d.}{32} \qquad 32\times1.25=40$ pence $\quad =\overset{s.}{3}\ \ \overset{d.}{4}.$

EXAMPLE IV.

Suppoſe ſugar imported from the Britiſh plantations pay a cuſtom duty of 12s. 4d. per hundred weight Avoirdupoiſe; what is that per hundred new weight?

$\overset{s.}{12}\ \ \overset{d.}{4}=\overset{d.}{148} \qquad 148\times1.1160714=165.1785672 \ =\overset{s.}{13}\ \ \overset{d.}{9\tfrac{1}{4}}$ nearly.

EXAMPLE V.

At 6l. 14s. per ton Avoirdupoiſe, what is that per ton new weight?

$\overset{l.}{6}\ \ \overset{s.}{14}=\overset{s.}{134} \qquad 134\times1.1160714=149.5535676 \ =\overset{l.}{7}\ \ \overset{s.}{9}\ \ \overset{d.}{6\tfrac{1}{2}}$ nearly.

Theſe reductions are made upon a ſuppoſition that a cubic foot of water weighs exactly 1000 ounces Avoirdupoiſe, according to the preſent ſtandard. Suppoſe that ſhould not be the caſe, but that it be found by the experiments that a cubic foot, according to the ſcale laid down, weighs only 995 ounces, then the ounce weight, ariſing from the diviſion of the weight of a cubic foot of water into 1000 equal parts, will be leſs than the preſent ſtandard, in the proportion of 1000 to 995, or 200 to 199; therefore 200:199::1:.995, the weight of the Avoirdupoiſe ounce in this caſe, compared with the preſent ſtandard. Now if this ſhould be found to be the reſult of the experiments, or that the new ounce ſhould be found of any other greater or leſſer weight than the preſent ſtandard, the reductions are made in the ſame manner as the foregoing ones, regard being had to the difference in the new ounce weight; as for inſtance. ſuppoſe the new ounce .995,

	oz.
Then the new pound weight would be	19.9
And the common Avoirdupoiſe pound	16.

Then the old Avoirdupoiſe pound would be to the new one as 16 is to 19.9. Therefore 16:19.9::1:1.24375; that is, one pound new weight would be equal to 1.24375 pounds Avoirdupoiſe weight. Then, as before, if any number of pounds new weight be multiplied by this factor, 1.24375, the product will be the number of pounds Avoirdupoiſe equal thereto. In this caſe 248 new weight will be found equal to 308.45 Avoirdupoiſe, that is 248×1.24375=308.45. After the ſame manner the rate per pound, hundred, or ton, new weight, may be reduced to the rate, by Avoirdupoiſe weight, equivalent to it. By proceeding in the ſame manner all other new Weights and Meaſures, or the rates thereof, may be reduced to the old or thoſe in preſent uſe.

In all the following reductions the cubic foot of water is ſuppoſed to weigh exactly 1000 ounces Avoirdupoiſe, and the calculations made accordingly.

REDUCTION OF TROY,

WITH THE RATES THEREOF TO THOSE OF NEW WEIGHT.

Mr. Ward, in his Young Mathematician's Guide, p. 33, ſays, "That "the pound Avoirdupoiſe is equal to 14 oz. 11 dwts. 15½gr. Troy." Then conſequently the ounce Avoirdupoiſe is equal 437.46875 grains. Mr. Greaves, in his book on Weights and Meaſures, p. 37, ſays, "That "upon experiments made upon the ſtandard Troy and Avoirdupoiſe "Weights, it was found that 15 pounds Avoirdupoiſe were equal to "18lb. 2 oz. 15 dwts. Troy;" according to which, the Avoirdupoiſe ounce is equal to 437.5 grains, which is only .03125 grains more than what Mr. Ward makes it; and therefore we will venture to conclude that the Avoirdupoiſe ounce is equal to 437.5 grains; and conſequently, that the Avoirdupoiſe pound is equal to 14 oz. 11 dwts. 16 gr. Troy.

It is remarkable, that in making experiments, I could never meet with a ſet of weights that would agree amongſt themſelves, when tried in a pair of fine ſcales, though intended for ever ſo exact purpoſes; which muſt be owing to the want of care in adjuſting, and is a thing very materially neceſſary to be attended to.

The ounce Avoirdupoiſe (ſuppoſe equal to the ounce new weight) contains	437.5 Grains.
The ounce Troy contains	480. Ditto.

Conſequently the ounce Troy is to the ounce new or Avoirdupoiſe, as 480 is to 437.5: therefore, 480:437.5::1:.9114583, by which, if any number of ounces new weight be multiplied, the product will be the number of ounces Troy; as for inſtance: 460 ounces new or Avoirdupoiſe weight. $460\times.9114583=419.270818=\overset{\text{oz.}}{419}\ \overset{\text{dwt.}}{5}\ \overset{\text{gr.}}{10}$ nearly.

The pound Avoirdupoiſe weight, as ſtated above, is	=7000 Grains.
And the pound Troy is	=5760 Ditto.

Conſequently the pound Troy is to the pound Avoirdupoiſe weight, as 5760 is to 7000, or as 144 to 175; therefore, 144:175::1:1.2152777; by which common factor, if any number of pounds Avoirdupoiſe be multiplied, the product will be the number of pounds Troy equal thereto: as if it was required to know how many pounds Troy are contained in 520 pounds Avoirdupoiſe weight, $520\times1.2152777=631.944404$ $=\overset{\text{lb.}}{631}\ \overset{\text{oz.}}{11}\ \overset{\text{dw.}}{6}\ \overset{\text{gr.}}{15}$ nearly.

One pound new weight is propoſed to be =20 ounces Avoirdupoiſe nearly, and therefore is one fourth part greater than the pound Avoirdupoiſe.

One pound Avoirdupoiſe, as remarked before, contains	7000 Grains.
To which add one fourth part of itſelf	1750 Ditto.
Therefore one pound new weight contains	8750 Grains.

Then conſequently the pound Troy is to the new pound as 5760 is to 8750, or as 576 is to 875: therefore, 576:875::1:1.5190972; by which, if any number of pounds new weight be multiplied, the product will be the number of pounds Troy contained therein; as 840 pounds new contains 1276.041648 pounds Troy weight, becauſe 840 $\times 1.5190972 = 1276.041648 = \overset{\text{lb.}}{1276}\ \overset{\text{oz.}}{0}\ \overset{\text{dwt.}}{10}$ nearly.

The ſame common factors, or multipliers, which reduce new to Troy weight, will alſo reduce the rates of Troy to the rates new weight, in the ſame manner as in Avoirdupoiſe weight: according to the following

GENERAL RULE.

If the rate be by the ounce Troy, multiply it by .9114583, and if it be by the pound, by 1.5190972, and the product in each caſe will be the rate new weight.

EXAMPLE I.

Plate of ſilver, ungilt, pays a duty upon importation of 2s. 2d. per ounce Troy, what is that per ounce new weight?

$\overset{s.}{2}\ \ \overset{d.}{2}=26$ pence, $26\times.9114583=23.6979158=\overset{s.}{1}\ \ \overset{d.}{11\frac{1}{4}}$ nearly.

EXAMPLE II.

Plate of wrought gold imported pays a duty of 1l. 10s. per ounce Troy, what is that per ounce new weight?

$\overset{l.}{1}\ \ \overset{s.}{10}=30$ ſhillings, $30\times.9114583=27.343749=\overset{l.}{1}\ \ \overset{s.}{7}\ \ \overset{d.}{4}$ nearly.

It is probable that the rates of cuſtom duty mentioned in the foregoing examples are not what are now actually charged: they are taken from a book entitled "The Ship Owner's Manual."

EXAMPLE III.

At 8l. 16s. per pound Troy, what is that per pound new weight?

$\overset{l.}{8}\ \ \overset{s.}{16}=8.8$ pounds, $8.8\times1.5190972=13.36805536=\overset{l.}{13}\ \ \overset{s.}{7}\ \ \overset{d.}{4\frac{1}{4}}$ nearly.

Before we entirely diſmiſs the ſubject of weights, it ſeems neceſſary to ſay ſomething about thoſe that are not generally made uſe of, but only in particular places, and for weighing of particular kinds of commodities. The firſt is what is commonly called the long hundred, containing 120 pounds, Avoirdupoiſe weight. It is uſed in all or moſt parts of England, though not every where for the ſame kind of articles, cuſtom being the prevailing motive for it. It is juſt one fourteenth part more than the common Avoirdupoiſe hundred, and therefore contains 1920 ounces Avoirdupoiſe; and as the propoſed new hundred weight contains 2000 ounces, it is to the new hundred as 1920 is to 2000, or as 24 to 25.

Therefore, 24:25::1:1.0416666, by which, if any number of hundreds new weight be multiplied, the product will be the number of long hundreds equivalent thereto; as, 140 hundred new weight is equal to 145.833324 hundreds long weight, becauſe 140×1.0416666 $=145.833324=\overset{\text{cwt.}}{145}\ \overset{\text{qr.}}{3}\ \overset{\text{lb.}}{10}$.

The Derbyſhire lead is generally ſold by the fodder; 16 pieces, or half pigs, are called a fodder, but ſubject to be weighed, and the over or under weight accounted for. The weight of a fodder is different at different places; as at the furnaces or mills where it is

	Cwt.		lb.		oz.
ſmelted	24	of	112	Avoir. to the hun.	=43008
Derby	22½	of	112	. . . ditto	=40320
Gainſbro' and Stockwith	21½	of	112	. . . ditto	=38528
Hull	19½	of	120	. . . ditto	=37440
London	19½	of	112	. . . ditto	=34944

The ounces contained in one ton, the new propoſed weight, being 40000, the common factors or multipliers for reducing thoſe tons to fodders of each denomination, or the rate per new ton to that of each fodder equivalent thereto, will be thus found:

			cwt.		lb.	
43008:40000::1:.9300595	for the furnace or mill fodder	of	24	of	112	Avoird.
40320:40000::1:.9920634	for the Derby fodder	of	22½		ditto.	
38528:40000::1:1.0382059	for the Gainſb. and Stock. fod.	of	21½		ditto.	
37440:40000::1:1.068376	for the Hull fodder	of	19½	of	120	ditto.
34944:40000::1:1.1446886	for the London fodder	of	19½	of	112	ditto.

Therefore if the number of tons new weight be multiplied by any of the above common factors, the product will be the number of fodders equivalent thereto; and alſo, if the rate per fodder be multiplied by any of them, the product will be the rate per ton new weight equal thereto, in each reſpective denomination.

MEASURE OF CAPACITY.

In order to eſtabliſh one common Meaſure of Capacity, let the buſhel contain one cubic foot, or 1728 cubic inches.

Then 1 Gallon, or the eighth part, will be . . . . . 216 inches.
1 Quart . . . . 54 ditto.
1 Pint . . . . 27 ditto.

Let the gallon of 216 cubic inches be the univerſal ſtandard, or integer, from which all the other denominations of meaſure are derived. For the conveniency and accommodation of buſineſs, it ſeems neceſſary to form three different tables of the Meaſure of Capacity, though all depending upon the ſtandard gallon, namely, Dry or Corn Meaſure, Wine Meaſure, and Ale and Beer Meaſure.

DRY OR CORN MEASURE.

2 Pints	MAKE	1 Quart =	54 cubic inch.	2 Quarts 1 Quartern.
4 Quarts		1 Gallon =	216 . ditto . .	2 Gallons 1 Peck.
8 Gallons		1 Buſhel =	1728 . ditto	
10 Buſhels		1 Quarter=	17280 . ditto.	

The value of corn between the buyer and the ſeller is generally eſtimated by the quarter, or ſometimes in ſmall quantities to the conſumers, by the buſhel.

The old corn buſhel contains . . . . 2150.4 cubic inches.
The new propoſed one . . . . 1728 ditto.

Then conſequently the old buſhel is to the new propoſed buſhel, as 2150.4 is to 1728; therefore, 2150.4:1728::1:.8035714, by which, if any number of buſhels new meaſure be multiplied, the product will be the number of old buſhels equal thereto. And alſo, if the rate per buſhel old meaſure be multiplied by it, the product will be the equivalent rate per new buſhel. As, 48 buſhels new meaſure is equal 38.5714272 buſhels old meaſure $=\overset{\text{bu.}}{38}\ \overset{\text{pks.}}{2}\ \overset{\text{qns.}}{1}$ or $\overset{\text{bu.}}{38}\ \overset{\text{gal.}}{4}\ \overset{\text{qts.}}{2}\ \overset{\text{p.}}{0}\ \overset{\text{in.}}{15}$ nearly. Alſo 6s. per buſhel old meaſure is equal to 4.8214284 ſhillings per buſhel new meaſure; becauſe $6\times.8035714=4.8214284=\overset{\text{s.}}{4}\ \overset{\text{d.}}{9\frac{3}{4}}$ nearly.

The old quarter contains . . . . . . 17203.2 cubic inches.
The new propoſed one . . . . 17280. ditto.

Then conſequently the old quarter is to the new propoſed one, as 17203.2 is to 17280; therefore, 17203.2:17280::1:1.0044642; by which common factor, if any number of quarters new meaſure be multiplied, the product will be the number of quarters old meaſure. Alſo, if the rate per quarter old meaſure be multiplied by the ſame factor, the product will be the rate per quarter new meaſure equal to it; as, 64 quarters new meaſure are equal 64.2857088 quarters old; becauſe $64 \times 1.0044642 = 64.2857088 = \overset{\text{qr.}}{64} \quad \overset{\text{bu.}}{2} \quad \overset{\text{pk.}}{1}$ nearly. Alſo, 48 ſhillings per quarter old meaſure is equal to 48.2142816 ſhillings new; becauſe $48 \times 1.0044642 = 48.2142816 = \overset{\text{l.}}{2} \quad \overset{\text{s.}}{8} \quad \overset{\text{d.}}{2\frac{1}{2}}$ nearly.

The conſolidated duty upon one quarter of malt is 12s. 6d.=150 pence, $150 \times 1.0044642 = 150.66963$ pence $= \overset{\text{s.}}{12} \quad \overset{\text{d.}}{6} \quad \overset{\text{f.}}{2.67852}$, being only $2\frac{67852}{100000}$ farthings more than the old quarter.

The old and new quarter are ſo nearly equal in quantity to each other, that the difference in the price of corn, or the rate of exciſe, is ſo inconſiderable, as not to be worth notice.

I have often conſidered the form of the Wincheſter buſhel as not well adapted to exactneſs. The ſtatute directs that it ſhall be made "with a plain and even bottom, being eighteen inches and a half wide "throughout, and eight inches deep." I never tried one made of wood for common uſe that was correct to this width. Neither do I think it is poſſible to make them to continue ſo, in the manner they are now executed. I preſume that if they were made octagonal, with each ſide of one plain board ſtanding upright, a greater degree of exactneſs might be obtained, and in their uſe, would be, if either, more convenient. Suppoſe the ſide of the octagon 6.5 inches, the depth 8.47 inches, I believe the cubic content would be 1727.8888 inches, which is near enough to the truth.

WINE MEASURE.

The price of wine between the buyer and the ſeller is computed by the gallon, except in ſuch caſes that the purchaſe is made in bulk, as imported, by the pipe, butt, or hogſhead, &c. The cuſtom duty upon wines imported is always made by the ton of 252 gallons; but upon rum, brandy, and other ſpirituous liquors, by the gallon.

It is preſumed that the meaſures, according to the following table, are as well adapted to the conveniencies of trade as any can be.

TABLE OF WINE MEASURE.

2 Pints	MAKE	1 Quart.
4 Quarts		1 Gallon.
67½ Gallons		1 Hogſhead.
135 Gallons, or 2 Hogſheads		1 Pipe.
270 Gallons, or 2 Pipes . . .		1 Ton.

The old wine gallon contains . . . . 231 cubic inches.
The new propoſed one . . . . 216 ditto.

Therefore the old one is to the new one as 231 is to 216.

That is, 231:216::1:.9350649, the common factor or multiplier for reducing new to old gallons; or alſo for reducing the rates per gallon old to equivalent rates per gallon new meaſure. As, 84 gallons new meaſure are equal to 78.5454516 gallons old; becauſe 84×.9350649 =78.5454516=78½ gallons nearly. In like manner, 6s. 6d. per gallon old meaſure is equal to 6s. 1d. new meaſure; becauſe $\overset{s.}{6}\ \overset{d.}{6}=6.5\times.9350649=6.07792185=\overset{s.}{6}\ \overset{d.}{1}$ nearly.

The old wine ton is 252 gallons, which, at 231
cubic inches per gallon, is . . . . 58212 cubic inches.
The new propoſed one is 270 gallons, which, at
216 cubic inches per gallon, is . . . . 58320 ditto.

From whence it appears that the old is to the new wine ton as 58212 is to 58320, or as 539 is to 540; therefore, 539:540::1:1.0018552, being a common factor, by which, if any number of new tons, or the rate per old ton, be multiplied, the firſt product will be the number of old tons, and the ſecond the rate per new ton equivalent thereto; as, 20 new tons are=20.0371104; becauſe 20×1.0018552=20.0371104=20 tons and 9 gallons nearly.

Portugal, Madeira, and Spaniſh wines, imported in Britiſh built ſhips into any port in England, except London, pay a cuſtom duty of 16l. 16s. per ton of 252 gallons old meaſure, which is 16l. 16s. 7½d. per ton new meaſure; for $\overset{\text{l.}}{16}\ \overset{\text{s.}}{16}=16.8$ pounds, $\times 1.0018552=16.83116736$ $=\overset{\text{l.}}{16}\ \overset{\text{s.}}{16}\ \overset{\text{d.}}{7\frac{1}{2}}$

ALE AND BEER MEASURE.

Ale and Beer are generally ſold by the butt, hogſhead, half hogſhead, barrel and half barrel, or kilderkin; but moſtly by the barrel, by which the duty of exciſe is computed and charged. The following table is propoſed to be ſubſtituted in the place of that now made uſe of.

TABLE OF ALE AND BEER MEASURE.

216 Cubic inches	MAKE	1 Gallon.
24 Gallons		1 Kilderkin.
2 Kilderkins, or 48 Gallons		1 Barrel.
1½ Barrel, 3 Kilderkins, or 72 Gallons		1 Hogſhead.

The old ale or beer gallon contains . . . . 282 cubic inches.
The new propoſed one . . . . 216 ditto.

Then conſequently the old is to the new ale gallon as 282 to 216, or as

47 is to 36; therefore, 47:36::1:.7659574, which is a common factor, by which if any number of new gallons be multiplied, the product will be the number of old gallons contained therein. Or if the rate per gallon old meaſure be multiplied thereby, the product will be the rate per new gallon. As for inſtance, 120 gallons new meaſure, $120\times.7659574=91.914888$ old meaſure. Alſo 16d. per gallon new meaſure is equal to $12\frac{1}{4}$d. old meaſure; for $16\times.7659574=12.2553184=\overset{\text{d.}}{12\tfrac{1}{4}}$

The old ale or beer barrel of 36 gallons old meaſure
contains . . . . 10152 cubic inches.
The new one of 48 gallons new meaſure . . . 10368 ditto.

Then conſequently the old is to the new barrel as 10152 is to 10368, or as 47 is to 48: therefore, 47:48::1:1.0212766, by which if any number of barrels new meaſure, or the rate per barrel old meaſure, be multiplied, the products will be the number of barrels old meaſure, and the rate per barrel new meaſure, each reſpectively equal thereto. As, 48 barrels new meaſure are equal to 49.0212768 barrels old meaſure; becauſe $48\times1.0212766=49.0212768=49$ barrels and one gallon nearly. Alſo 36s. per barrel old meaſure is equal to 36.7659576 per barrel new meaſure; becauſe $36\times1.0212766=36.7659576=\overset{\text{s.}}{36}\ \overset{\text{d.}}{9\tfrac{1}{4}}$ nearly.

The neat exciſe duty on one barrel of ſtrong ale or beer of 36 gallons old meaſure, made by brewers within the bills of mortality of the city of London is 5s. 6d. this is reduced to the rate per barrel new meaſure thus, $\overset{s.}{5}\ \overset{d.}{6}=5.5$ ſhillings, $\times 1.0212766=5.6170213=\overset{s.}{5}\ \overset{d.}{7\frac{1}{2}}$ nearly. This is an indulgence granted to the London brewers only, as in all other parts of the kingdom this duty of 5s. 6d. is paid on the barrel of 34 gallons.

The old country ale or beer barrel of 34 gallons contains 9588 cubic inches, and conſequently is in proportion to the new propoſed one as 9588 is to 10368, or as 799 to 864: conſequently, 799:864::1:1.0813517; by which common factor the new barrel may be reduced to old, and the rate per old to the equivalent rate per new barrel, as before.

By this it appears that the country duty of exciſe upon the new barrel ſhould be 5s. 11¼d. for $\overset{s.}{5}\ \overset{d.}{6}=5.5\times 1.0813517=5.94743435=\overset{s.}{5}\ \overset{d.}{11\frac{1}{4}}$ nearly.

The factors thus found for the different Weights and Meaſures taken notice of, reduce the propoſed new Weights and Meaſures to old ones equivalent thereto, as alſo the rates by the old Weights and Meaſures to thoſe by the new propoſed ones in proportion to them. It may be neceſſary to obſerve, that the reciprocals to thoſe factors have the contrary effect; that is, they reduce the old Weights and Meaſures to the new propoſed ones, and the rates by thoſe new propoſed Weights and Meaſures to the proportional rates by the old ones.—Theſe reciprocal factors are found by making the antecedent conſequent and conſequent antecedent; as for inſtance: in finding the common factor for reducing hundred weights Avoirdupoiſe to hundred weights new weight, p. 16, it is 112:125::1:1.1160714; but by making the antecedent conſequent, or reverſing the proportion of 112 to 125, it will be 125:112::1:.896, the reciprocal factor required. The factors may be found without forming theſe proportions by the following

GENERAL RULE.

Divide the number of ounces, cubic inches, or of any other denomination (in which the old and new Weights or Meaſures coincide in quantum or value) contained in an integer, or one of the new Weight or Meaſure; by the number of ounces, cubic inches, &c. (equally circumſtanced as to quantum or value) contained in an integer, or one of the old Weight or Meaſure, and the quotient will be the common factor for reducing the new Weights or Meaſures to old ones, or the rates by the old Weights or Meaſures to thoſe equivalent thereto by the new ones. Again. If the diviſor be made the dividend, and the dividend the diviſor, the quotient will be the reciprocal factor for reducing the old Weights or Meaſures to new ones, and the rates by the new Weights and Meaſures to thoſe by the old ones.

As for example. In 112lb. or one hundred weight Avoirdupoiſe, are 1792 ounces, and in the new propoſed hundred weight, are 2000 ounces; then, according to the rule, 2000 divided by 1792, or, which is the ſame, 125 by 112, the quotient, 1.1160714, is the factor for the firſt purpoſe, and 1792 divided by 2000, or 112 by 125, the quotient, .896, is the factor for the ſecond purpoſe. And ſo of all others.

That the common factors for theſe reductions may be more eaſily referred to, they are put down in the following table, with each of their reſpective reciprocals.

	Factors for reducing new Weights and Meaſures to the old ones, and for reducing the rates by the preſent old Weights and Meaſures to equivalent ones by the new Weights and Meaſures.		Reciprocal Factors for reducing old Weights and Meaſures to new ones, and for reducing the rates by the new Weights and Meaſures to equivalent ones by the old Weights and Meaſures.
Avoirdupoiſe Weight	1.25	Pounds	.8
	1.1160714	Hundreds or Tons	.896
Troy Weight	.9114583	Ounces	1.0971428
	1.5190972	Pounds	.6582857
Long Hundred, 120lb.	1.0416666	Hundreds	.96
Derbyſhire Lead	.9300595	Fodders at Mill or Cupolas	1.0752
	.9920634	Ditto at Derby	1.008
	1.0382059	Ditto at Gainſbro' or Stockwith	.9632
	1.068376	Ditto at Hull	.936
	1.1446886	Ditto at London	.8736
Dry Meaſure	.8035714	Buſhels	1.2444444
	1.0044642	Quarters	.9955555
Wine Meaſure	.9350649	Gallons	1.0694444
	1.0018552	Tons	.9981481
Ale and Beer Meaſure	.7659574	Gallons	1.3055555
	1.0212766	Barrels of 36 Gallons	.9791666
	1.0813517	Barrels of 34 Gallons	.9247685

There are probably ſome other Weights and Meaſures, which cuſtom has eſtabliſhed in different parts of England, beſides thoſe taken notice of in this tract; but if there be, it is preſumed they are derived from Avoirdupoiſe weight, and cubic inches, or other meaſure depending thereupon. If there be, the method of finding factors or common multipliers has been ſo fully inveſtigated, that it is impoſſible any difficulties ſhould ariſe in reducing them. It may be expected that ſomething ſhould have been ſaid about Apothecaries' weights, or ſuch as are made uſe of in the compoſition of medicines: that is perfectly unneceſſary, as drugs in general are bought and ſold by Avoirdupoiſe weight, and the other are all compoſed of, or derived from Troy weight.

By the common factors or multipliers in the foregoing table, the rates by the Weights and Meaſures now in uſe are eaſily and expeditiouſly reduced to others equivalent by the new ones propoſed, by any perſon that is acquainted with decimal arithmetic. Daily practice would ſoon bring merchants and tradeſmen to be as good judges about the value of their commodities by the new propoſed, as by the preſent Weights and Meaſures, and be equally expert in reckoning by them. As to other matters, I ſhould not think it a work of ſuch great magnitude, but that I could in a moderate time, furniſh tariffs of all the different rates of cuſtoms, exciſe, tolls and duties upon inland navigations, freight, carriage, and wharſage, &c. or what elſe might ariſe in conducting buſineſs of every kind throughout England.

It may be ſaid that, as the theory is not confirmed by experiments, all that has been done is of no ſignification. I certainly would have attempted to have obviated this objection, but for ſome unſurmountable obſtacles which are in the way. Firſt, having no ingenious, expert workman near at hand to lend his aſſiſtance in making the neceſſary apparatus; and the place of my reſidence being at too great a diſtance from London to have any aſſiſtance from thence; but, above all, the effects of old age, which has rendered my ſight too weak for ſuch nice experiments. I am therefore under the neceſſity of reſting contented with having pointed out what ſeems to me the way to obtain certain Standards of Engliſh Weights and Meaſures dependant upon each other.

To find the length of a pendulum vibrating ſeconds, ſeems very eaſy at firſt ſight; but when put in practice, it is found to be attended with much difficulty, occaſioned by a number of interfering circumſtances. If it cannot be found to that mathematical exactneſs, which ſome gentlemen may think neceſſary for the purpoſe; why not admit Mr. Troughton's ſcale, mentioned by Mr. Whitehouſe in his book, as the Engliſh Standard for Meaſure, and let the Standard for Weights be adjuſted to it, upon the principle of one cubic foot of water (according to that meaſure) weighing one thouſand ounces, ſo adjuſted? This would anſwer all the purpoſes of trade. It is agreed by all writers upon hydroſtatics which I have read, that one cubic foot of water weighs 1000 Avoirdupoiſe ounces; this, I preſume, they have founded part upon the reſult of experiments laid before the Royal Society, and part from their own. Theſe are pretty good authorities, and, I am perſuaded, will be found true, or very nearly ſo, by any perſon who will be at the expence and trouble of making the experiments, which I hope ſomebody better qualified than myſelf will do, and oblige the public with the reſult thereof.

It may be ſuggeſted, that ſomething ought to be ſaid about Upheaped Meaſure, by which it is in many places cuſtomary to buy and ſell coals, as alſo apples, pears, potatoes, and other kind of garden ſtuff, &c. For theſe purpoſes it is neceſſary that the different kind of Meaſures made uſe of ſhould be ſo conſtructed, that their diameters may bear ſuch proportions to their depth, that the upheaping, or conical part, ſhall be in the ſame ratio to the internal cubic content of each reſpective Meaſure throughout. This way of meaſuring is vague and uncertain; and therefore it would be much better to have it entirely laid aſide, and weighing ſubſtituted in its place. In many parts of England it is already done, particularly in Lancaſhire, where ſeveral of theſe articles are now bought, ſold, and rated by weight.

FINIS.

MVSEVM
BRITAN
NICVM

Fig:1.

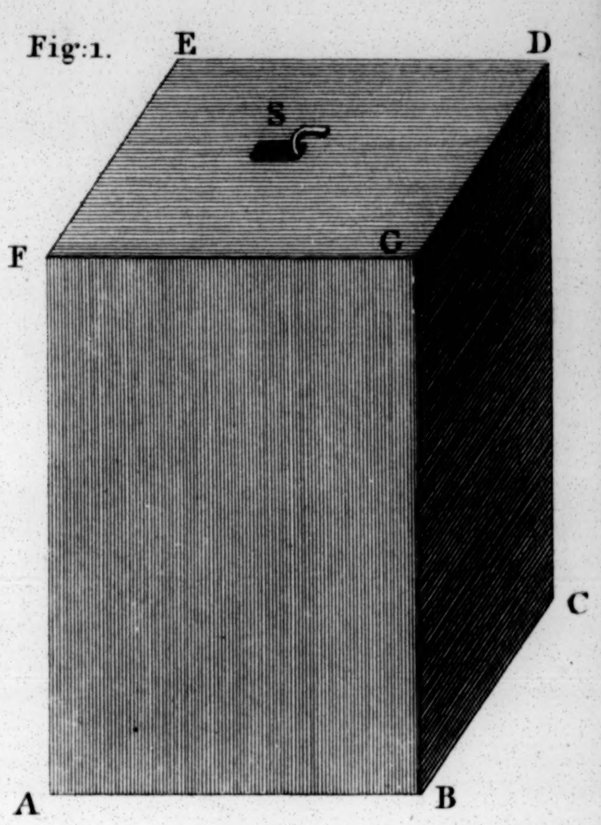

Fig:2.